AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A control device of a legged mobile robot that travels by moving legs extended from its body, said control device being configured to sequentially determine instantaneous values of a desired motion and a desired floor reaction force of the legged mobile robot by using a dynamic model that expresses a relationship between at least a motion of the robot and a floor reaction force, and also to control an operation of the robot at the same time so as to make the robot follow the determined instantaneous values of the desired motion and the desired floor reaction force, comprising:

means for setting a permissible range of a restriction object amount, the restriction object amount being a vertical component of a floor reaction force moment or a component of the floor reaction force moment in floor surface normal line direction to be applied to a robot in operation, following the desired motion and the desired floor reaction force; and

means for determining instantaneous values of the desired motion and the desired floor reaction force, on the basis of the permissible range and at least a difference between a desired state amount, related to a posture of the robot about a vertical axis or about a floor surface normal line axis, and an actual state amount, related to the posture of the robot about the vertical axis or about the floor surface normal line axis, of the robot, such that a deviation between a floor reaction force moment balancing with the desired motion on the dynamic model and a floor reaction force moment of the desired floor reaction force approximates the difference to zero, while having the restriction object amount, which is associated with the desired floor reaction force, fall within the permissible range.

2. (Previously Presented) The control device of a legged mobile robot

according to Claim 1, wherein the means for determining instantaneous values comprises means for determining a compensating floor reaction force moment, which is an additional floor reaction force moment for approximating the difference to zero on the basis of the difference, and means for determining a correction amount of a predetermined provisional instantaneous value such that the restriction object amount does not exceed the permissible range on the basis of at least a floor reaction force moment that balances with the predetermined provisional instantaneous value of the desired motion on the dynamic model and the compensating floor reaction force moment, wherein the provisional instantaneous value is corrected on the basis of the determined correction amount so as to determine an instantaneous value of the desired motion.

3. (Original) The control device of a legged mobile robot according to Claim 2, further comprising means for determining a model correction floor reaction force moment, which is an additional floor reaction force moment for approximating a state amount of the dynamic model to a predetermined state amount, wherein the means for determining a correction amount of a predetermined provisional instantaneous value of the desired motion determines a correction amount of a provisional instantaneous value of the desired motion such that the restriction object amount does not exceed the permissible range on the basis of at least a floor reaction force moment that balances with the predetermined provisional instantaneous value on the dynamic model, the compensating floor reaction force moment, and the model correction floor reaction force moment.

4. (Previously Presented) The control device of a legged mobile robot according to Claim 2, wherein the correction amount of the predetermined provisional instantaneous value is a correction amount of a motion that changes a vertical component or a component in floor surface normal line direction of an angular momentum changing rate of the robot.

5. (Original) The control device of a legged mobile robot according to Claim 4, wherein the motion that changes the vertical component or the component in floor

surface normal line direction of the angular momentum changing rate of the robot is a motion of a body of the robot and/or an arm extended from the body of the robot.

6. (Previously Presented) A control device of a legged mobile robot that travels by moving legs extended from its body, said control device being configured to sequentially determine an instantaneous value of a desired motion of the legged mobile robot by using a dynamic model that expresses a relationship between at least a motion of the robot and a floor reaction force, and also to control an operation of the robot at the same time so as to make the robot follow the determined instantaneous value of the desired motion, comprising:

means for setting a permissible range of a restriction object amount, the restriction object amount being a vertical component of a floor reaction force moment or a component of the floor reaction force moment in floor surface normal line direction to be applied to a robot in operation, following the desired motion;

means for determining a compensating floor reaction force moment, which is an additional floor reaction force moment for bringing a difference between a desired state amount related to a posture of the robot about a vertical axis or a floor surface normal line axis and an actual state amount of the robot close to zero on the basis of at least the difference; and

means for determining an instantaneous value of the desired motion such that the restriction object amount, which is determined on the basis of a floor reaction force moment balancing with the desired motion on the dynamic model and the compensating floor reaction force moment, falls within the permissible range.

7. (Original) The control device of a legged mobile robot according to Claim 6, further comprising means that defines the restriction object amount falling within the permissible range as a desired floor reaction force moment, and controls the operation of the robot so as to make the robot follow the desired floor reaction force moment.

8. (Previously Presented) The control device of a legged mobile robot according to Claim 6, wherein the means for determining an instantaneous value of

the desired motion determines an instantaneous value of the desired motion by adjusting a motion that changes a vertical component or a component in floor surface normal line direction of an angular momentum changing rate of the robot among motions of the robot in order to hold the restriction object amount, which depends on a floor reaction force moment balancing with the desired motion on the dynamic model and the compensating floor reaction force moment, within the permissible range.

9. (Original) The control device of a legged mobile robot according to Claim 8, wherein the motion that changes a vertical component or a component in floor surface normal line direction of an angular momentum changing rate of the robot is a motion of a body of the robot and/or an arm extended from the body.

10. (Previously Presented) A control device of a legged mobile robot that travels by moving legs extended from its body, said control device being configured to sequentially determine an instantaneous value of a desired motion of the legged mobile robot by using a dynamic model expressing at least a relationship between a motion of the robot and a floor reaction force, and also to control an operation of the robot at the same time so as to make the robot follow the determined instantaneous value of the desired motion, comprising:

means for setting a permissible range of a restriction object amount, the restriction object amount being a vertical component of a floor reaction force moment or a component of the floor reaction force moment in floor surface normal line direction to be applied to a robot in operation, following the desired motion;

means for sequentially determining a provisional instantaneous value of the desired motion;

means for determining a compensating floor reaction force moment, which is an additional floor reaction force moment for bringing a difference between a desired state amount related to a posture of the robot about a vertical axis or a floor surface normal line axis and an actual state amount of the robot close to zero on the basis of at least the difference; and

means for determining an instantaneous value of the desired motion by

defining a portion of the restriction object amount, which deviates from the permissible range, as a moment correction manipulated variable, the restriction object amount being determined on the basis of a floor reaction force moment balancing with a provisional instantaneous value of the desired motion on the dynamic model and the compensating floor reaction force moment, and by correcting the provisional instantaneous value of the desired motion on the basis of the moment correction manipulated variable such that the deviating portion indicates a tendency to decrease.

11. (Previously Presented) The control device of a legged mobile robot according to Claim 10, wherein the means for determining an instantaneous value of the desired motion determines an instantaneous value of the desired motion by determining a correction amount of a provisional instantaneous value of the desired motion on the basis of a result obtained by passing the moment correction manipulated variable through a low-pass filter, and then by correcting the provisional instantaneous value on the basis of the determined correction amount.

12. (Original) The control device of a legged mobile robot according to Claim 10, further comprising means for defining, as a desired floor reaction force moment, a floor reaction force moment corresponding to an already restricted restriction object amount that has been limited by restricting the restriction object amount, which is determined on the basis of a floor reaction force moment balancing with a provisional instantaneous value of the desired motion on the dynamic model and the compensating floor reaction force moment, to fall within the permissible range, and for controlling an operation of a robot so as to make the robot follow the desired floor reaction force moment.

13. (Previously Presented) The control device of a legged mobile robot according to claim 10, wherein the means for determining an instantaneous value of the desired motion determines an instantaneous value of the desired motion by correcting a motion for changing a vertical component or a component in floor surface normal line direction of an angular momentum changing rate of the robot on

the basis of a provisional instantaneous value of the desired motion.

14. (Original) The control device of a legged mobile robot according to Claim 13, wherein the motion for changing a vertical component or a component in floor surface normal line direction of an angular momentum changing rate of the robot is a motion of a body of the robot and/or an arm extended from the body.

15. (Previously Presented) The control device of a legged mobile robot according to claim 1, wherein the state amount related to a posture of the robot includes a yaw angle or a yaw angular velocity of the body of the robot.

16. (Previously Presented) The control device of a legged mobile robot according to claim 1, further comprising means for determining occurrence of a slippage of the robot, wherein the means for setting a permissible range variably sets the permissible range according to a determination result of the slippage determining means.

17. (Previously Presented) The control device of a legged mobile robot according to Claim 16, wherein the means for determining occurrence of a slippage of the robot determines the occurrence of a slippage on the basis of at least the ground speed of a distal portion of a leg in contact with the ground.

18. (Previously Presented) The control device of a legged mobile robot according to Claim 16, wherein the means for determining occurrence of a slippage of the robot comprises means for determining, on the basis of at least a temporal changing rate of an actual floor reaction force acting on a leg in contact with the ground and the ground speed of a distal portion of the leg, an apparent spring constant of the leg, and determines the occurrence of a slippage on the basis of at least the apparent spring constant.

19. (Previously Presented) The control device of a legged mobile robot according to Claim 16, wherein the means for determining occurrence of a slippage

of the robot determines the occurrence of a slippage on the basis of at least a result obtained by passing an actual floor reaction force acting on a leg in contact with the ground through a band-pass filter having a frequency passing characteristic in a range near a predetermined frequency.

Claims 20 – 79 (Cancelled)